



**Honours Project (CCIS)**

# **INTERIM REPORT**

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**BSc Computer Games (Software Development)**

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**"Except where explicitly stated, all work in this report, is my own original work and has not been submitted elsewhere in fulfilment of the requirement of this or any other award"**

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## Introduction

This chapter will provide the scope and justification of the project being undertaken. It will look at the many elements required to produce a frightening horror game as well as some common issues that arise when doing so. It will attempt to identify some potential solutions to these issues and provide relevant examples of these. An outline of the project will also be presented, including the objectives that will need to be completed in order to shape the project. Finally, a presentation and brief justification of the main hypothesis will be included.

### ***1.1 Background***

The horror genre has existed for nearly as long as the earliest forms of storytelling with mentions of demons and ghosts appearing in ancient Greek folklore thousands of years old (Lawson, 2012). In his famous essay “Supernatural Horror in Literature”, H.P Lovecraft traces horror back “The Book of Enoch”, an ancient Jewish religious text (Lovecraft, 1927). From these early roots, horror has persisted through all forms of story-telling and media, from literature to film, from theatre to houses of horror at amusement parks. It makes sense then that the horror genre of video games has existed for almost as long as games themselves, where the 1980s text game “Zork” found players navigating round a dark cave avoiding monsters (Rouse III, 2009).

Over the years it has become clear that many elements within horror games are responsible for successfully inducing a feeling of fear in players. Toprac et al (2011) detail effective sound design within horror games, showing that high volume, timed sound effects are very effective at creating feelings of tension. Vachiratamporn et al (2015) show that fear can be created by slowly building up tension before a scary event. It should be apparent that altering these elements will influence the game experience and therefore the feeling of fear in players. This task of altering design elements will usually fall to the designers. They can change the lighting in specific rooms, choose when to play a certain sound effect, confront the player with an enemy, and many other things, all with the goal of inducing as much fear as they can within their players. Tasking designers with this can cause some issues, however. Since so many aspects of the game need to be adjusted to find that “sweet-spot” of horror, many different types of designers will be required to work on each element. For larger horror games, this can be a very time-consuming and costly task even with many designers tackling each individual element. There is also the issue that different players all have different things that they find frightening and that designing a game to be scary to one player, may cause it to not be scary to another. A very common trap designers may fall into is to overuse certain elements that they know to be frightening, such as jump-scaries, but players quickly become desensitized to things they often encounter due to the unknown element being removed.

Some of the answers to these issues may lie in the world of affective gaming. Dekker et al (2007) experiment with heart rate monitors in survival horror games and finds that altering elements of the game, and thereby the pacing, based on the players heart rate results in a more frightening and enjoyable experience. This means players have a more tailored gameplay experience since the game adjusts dynamically to each player. The downside to this is that it is

not yet feasible to get the necessary sensors to consumers, either due to high costs, intrusive design and hindrances in technology like accounting for outside factors such as player movement.

Another technique that could offer potential solutions could come in the form of artificial intelligence. AI exists in almost every single video game in some form or another and can play a crucial role in level generation, NPC behaviour, dynamic visual effects and countless other applications. Horror games are no exception to this. In the simplest implementations, AI could be responsible for causing a monster to slowly approach the player, and in the more advanced applications, for example the Alien in Alien Isolation (Creative Assembly, 2014), seemingly clever entities can be created that learn from the players actions as they stalk them around the environment. In their game Left 4 Dead (Valve South, 2008), Valve introduced an “AI director” which was responsible for tracking how the player plays the game, and then altering certain things based on that such as how many enemies are spawning and the locations of guns and ammunition. While this is similar to the work of this project in that it affects the pacing of the game, Left 4 Dead is an action game, so the desired emotions to be experienced by the player will be different from those of a pure horror game, although further research of this AI will be crucial for the success of this project.

## **1.2 Project Overview**

### **1.2.1 Project Outline and Research Question**

Many elements must be considered by designers in order to elicit a fear response in players of horror games such as sound design, lighting, controls and many others. By altering these elements throughout the course of the game designers can further influence player’s emotional response. This can be very difficult and costly, and often results in shortcuts being taken that greatly inhibits a games potential to be as frightening as possible. This project aims to develop an AI system that dynamically alters certain elements of a horror game to investigate if this could be a potential solution to many of the problems mentioned. The main research question to be answered by this project is therefore:

Can artificial intelligence be used to dynamically alter elements of a horror game to successfully elicit a meaningful fear response in players?

### **1.2.2 Project Objectives**

In order to complete the main aims of this project, various objectives have been identified that must be completed. The first set of objectives will be completed by a literature review and will be key stepping stones in the construction of the project. The second set will be the primary objectives that must be completed to successfully obtain the information required to reach conclusions and determine the outcome of the project’s hypothesis.

#### **Literature review objectives:**

- **Determine the elements required to create fear in a horror game including the best practices within these elements.**

The creation of fear is one of the more difficult topics of this project due to the subjective nature of emotions. However, there are certain ways that are proven to be effective at creating fear in horror games. By identifying these ways and by researching

how they are best implemented, the game being created will have a much higher chance of being inherently frightening. It is also crucial to understand the key elements in horror games in order to properly develop the AI, since the AI will be responsible for altering these elements.

- **Investigate AI methods**

Since this project will involve developing an AI system, careful consideration will need to be made into the various types of AI and their potential effectiveness in the project. This will involve looking at how they have been used in the past, how to properly implement them, and if they are appropriate for the goals of this project.

- **How to model and measure emotions**

This project aims to study the emotional response elicited in players when playing through an AI-driven horror game. It is therefore crucial to understand how to effectively model human emotions both visually and numerically. Ways in which these emotions can be measured will also be investigated including qualitative and quantitative feedback. Qualitative feedback will provide the verbal account of the player's emotions, and quantitative will provide the raw data on which emotions are based.

- **Best testing practices from similar projects**

Past research of similar topics will need to be studied in order to gain an understanding of how best to design the testing phase of the project. This will include the number of participants as well as any criteria they must have such as age and experience with horror games. A suitable test environment must also be considered.

## **Primary Objectives**

- Develop a horror game
- Develop the AI system
- Design the testing phase
- Complete pilot study / preliminary testing
- Gather a suitable group of participants
- Carry out testing
- Analyse the results and draw conclusions

### **1.2.3 Hypothesis**

Horror games are made up of many different elements, and it is apparent that by altering these elements designers can have control over emotions elicited by players. This project aims to test if artificial intelligence can aid designers in this task by dynamically changing these elements within a horror game based on various parameters and produce a fear response in players. The main hypothesis for this project is therefore:

Artificial intelligence can successfully track and alter aspects of a horror game to produce measurable feelings of fear, anxiety and tension in players.

Similar projects such as Valve's AI director in Left 4 Dead show that dynamically altering elements of a game can produce more intense emotions and enjoyment of games.

## **Literature and Technology Review**

This section will aim to complete the objectives outlined in section 1.2.2. By doing this, essential knowledge will be gathered which will be used going forwards into the primary methods of the project. It will be carried out by researching previous work by others in similar topics in order to draw conclusions and justify the methods used in the primary objectives. The main sections of the literature and technology review are the objectives stated in section 1.2.2 and are:

- Determine the elements required to create fear in a horror game including the best practices within these elements.
- Investigate AI methods
- How to model and measure emotions
- Best testing practices from similar projects

### ***2.1 Determine the elements required to create fear in a horror game including the best practices within these elements***

When creating a horror game, or any horror media for that matter, there are some tried and true industry practices that must be considered throughout the entire development cycle. These are methods that have been proven to cause fear, dread and anxiety in consumers which are of course the desired emotions to be experienced when playing horror games. These methods are high level and fairly abstract and so can be applicable to many elements within a horror game's development.

#### **2.1.1 Inhibit coping mechanisms**

The first of these methods is inhibiting coping mechanisms. When humans experience the uncomfortable emotions associated with horror, they often display a variety of coping mechanisms some of which are categorized and displayed in Figure 1 - Brain circuitry involved in fear including coping mechanisms.

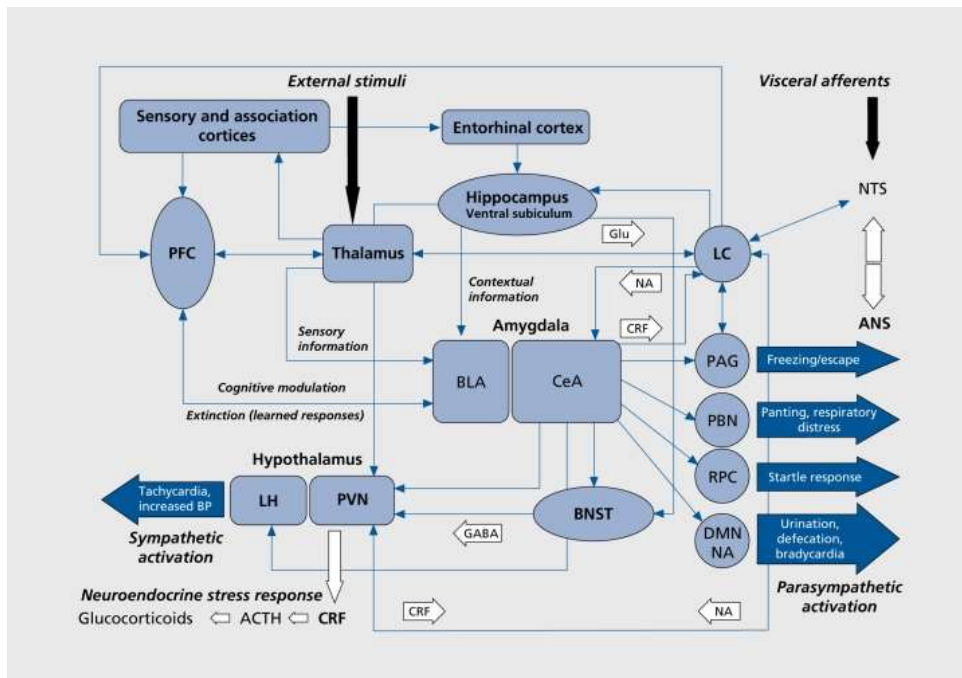


Figure 1 - Brain circuitry involved in fear including coping mechanisms (Steimer, 2002)

This schematic is taken from a very detailed paper by Thierry Steimer (2002), which also proves that inhibiting these coping mechanisms increases the feeling of anxiety. This is also proven by Laborit (1988), who shows that anxiety appears when a subject feels like they have no control over a situation, like when their coping mechanisms are not possible. This concept will be crucial to the success of the project, and by allowing the developed AI to track and alter coping mechanisms of test subjects it is more likely that feelings of anxiety will be produced. It will also be important when designing the testing phase of the project since player's will not only have in-game coping mechanisms such as running away or freezing in their tracks, but also external coping mechanisms like singing or closing their eyes. These will need to be observed to gain more useful qualitative data.

### 2.1.2 Specific cues and forewarning

Another proven way to elicit fear is by using specific cues and forewarning in order to build tension in players. In a study by de Wied et al (1997), it was shown that warning test subjects of graphic violence in a film clip caused them to experience more anxiety and suspense than those who were not warned. This same idea can be adapted to horror games, where building suspense with the use of forewarning to certain unpleasant events will cause more tension in the player. This forewarning can be done by specific cues. In a similar study by the National Institute of Mental Health, it is shown that "When confronted with fearful events, people eventually develop fear of specific cues that were associated with these events as well as to the environmental context in which the fearful event occurred" (Grillon, 2002). By identifying events that players find unsettling and frightening, specific cues to these events can be introduced by the AI, thereby giving forewarning and creating suspense.

### 2.1.3 Fear of the unknown

Another very important method used when creating a horror game is fear of the unknown. Famously quoted by Lovecraft (1927), "The oldest and strongest emotion of mankind is fear,

and the oldest and strongest kind of fear is fear of the unknown.” This has been shown to be true through countless forms of horror and is utilised in many horror games in some form or another. The effectiveness of this method is shown in many previous studies (Carleton, 2016, Cavallaro, 2002) and due to its simplicity to understand and implement this will be an essential concept to remember when progressing. It is due to the relationship between uncertainty and anxiety that make this method so powerful.

#### **2.1.4 Sound**

Sound design is paramount in creating fear and tension and careful consideration will need to be taken when designing the sound for the game. In his research of sound design in horror games, Grimshaw (2009) presents various techniques that are proven to increase feelings of uncertainty, anxiety and fear. Some of these include uncertainty about the location of a sound source or familiar sounds become warped and defamiliarized. All these techniques will be considered when designing the sounds. Munday (2007) states that dissonant music can be employed in horror games to create tension in players. He also mentions the effectiveness of altering music and sound based on certain parameters, which is of course very similar to what this project will attempt to do and provides justification for allowing the AI that will be developed to have control over the sound.

#### **2.1.5 Disempower the player**

Disempowering the player makes them feel vulnerable and therefore anxious (King, 2015). This can be done in several interesting ways. By placing the player in an unfamiliar setting that is difficult to navigate they feel a sense of unease. The setting can also be used to disempower the player by restricting their vision and therefore increasing the fear of the unknown. This can be done by placing them in cramped corridors and small rooms, or places with lots of objects in the way such as a forest. Darkness is also a very useful way to restrict players vision and cause them to feel tense (Perron, 2018). Not giving the player any weapons, or severely limiting access to weapons also disempowers them, since they have no way to fight back should they run into trouble. The AI will need to be able to alter aspects of the game that disempower the player for it to produce fear. It could do this by altering light levels, location of potential weapons, movement speed of the player and various other parameters, all of which disempower the player and increase vulnerability.

#### **2.1.6 Pacing and gameplay**

One of the quickest ways to break a player’s immersion and for them to stop experiencing the desired emotions in a game is to have them experience undesired emotions such as frustration and boredom. This was researched extensively by Csikszentmihalyi (1997), who came up with the concept of “flow”, which is essentially a two-dimensional relationship between the player’s skill level and the perceived difficulty of the game, highlighted in figure 3.



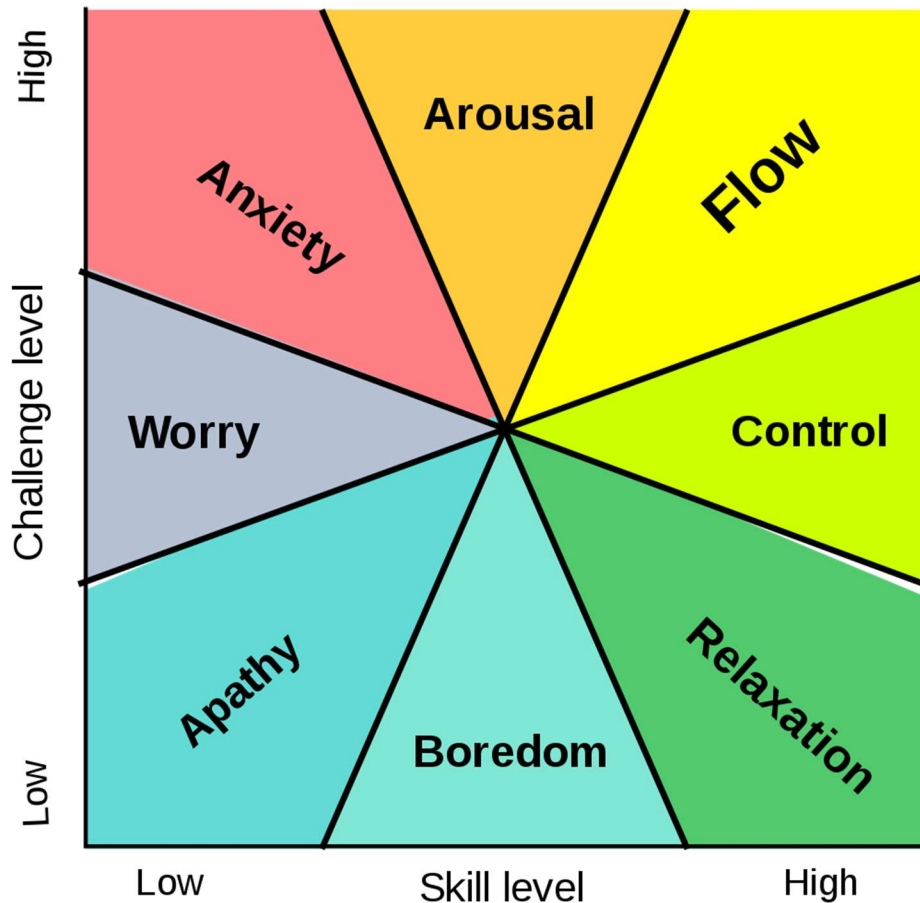


Figure 2- Flow model (Csikszentmihalyi, 1997)

Keeping players in the “flow” zone is crucial for maintaining immersion which will be very important when developing a horror game. Csikszentmihalyi lays out methods to increase the chances of achieving flow states which will have to be considered when designing the gameplay for the game. It’s also worth noting that a high difficulty and low skill level can result in feelings of anxiety which is a desired emotion when developing a horror game, so this will also be considered and tested when designing gameplay.

Proper pacing is also required to build tension and keep players engaged. Pacing is also essentially what the AI will be altering when it changes elements of the game, so it’s very important to understand the optimal pacing patterns. Perron (2004) shows the positive effect that building tension has on the overall fear experienced in a horror game. This means increasing tension slowly, building up to a big scare, instead of suddenly. It is also very important to allow players some respite, a time to relax between all the horror, otherwise they may become numb to horror or bored. Both requirements together form a “peaks and valleys” style of pacing, with sloping peaks of high-intensity followed by low-intensity valleys. This model of pacing will be used when designing the AI for the game in order to create as frightening an experience as possible.

## 2.2 Investigate AI methods

Aminder (2011) describes very similar research done by Valve and lists some criteria that their famous AI director needs to have:

- Represent intensity as a single value
- Increase intensity in response to in-game trauma
- Decay intensity to zero over time
- Create peaks and valleys

This list of criteria very closely matches the criteria needed for this project's AI. By representing the intensity, or how much fear the player is experiencing, as a single value it is much easier to track and alter this value, which is precisely the job of the AI. The AI will subject the player to in-game trauma by altering the previously mentioned elements. The intensity will need to decay over time in order to avoid positive feedback loops, where the player gets stuck in an endless loop of increasing intensity. And the AI will actively try to create peaks and valleys to stick to the model of pacing laid out in the previous section.

One method for developing AI that meets these criteria would be utility AI. Mark and Dill (2010) detail utility AI and its uses extensively. The core concept behind utility AI is that every possible action that could be taken can be represented by a single number, or its "utility." It can then pick from these actions based on their appropriateness in that moment, or the one with the highest utility. Since the AI developed for this project will have to choose which aspect of the game to alter at any given time, it will be very useful to have a way to compare all these aspects, which can be done by calculating their utility. It will also need a way in which to track all these various elements and turn them into useful concepts based on various parameters, something which utility AI can also do.

There are other forms of AI available, however since utility AI meets all the required criteria and due to familiarity with it, it will be an appropriate method for developing the AI for this project.

## ***2.3 How to model and measure emotions***

### **2.3.1 Modelling human emotion**

In order to better understand the emotions displayed by players of a horror game, a method for modelling emotions will be required. Barrett and Russell suggest that emotions can be mapped to a two-dimensional model which shows activation on the y-axis and pleasure on the x-axis, where activation is a measure of "how much?" and pleasure is a measure of positive or negative. This model is displayed in figure 2.

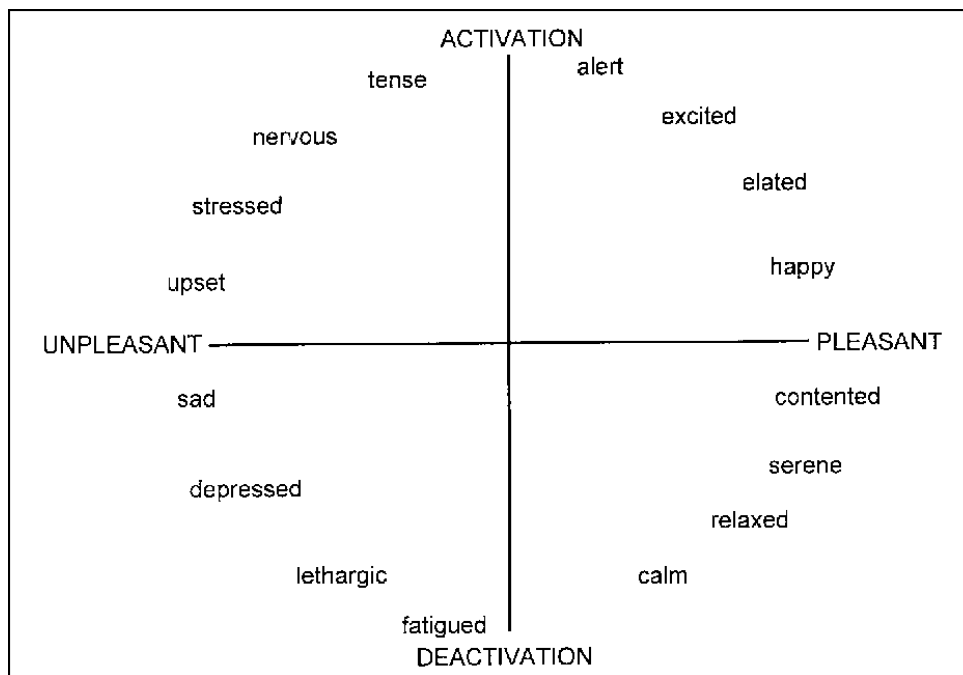


Figure 3- Two-dimensional structure of affect (Barrett, Russell, 1999)

From this model it is clear that the main emotions displayed in a horror game will be mapped to a high activation level and negatively on the pleasure dimension.

### 2.3.2 Measuring human emotion

Some method of measuring the activation and pleasure axes shown in Figure 2 will be required to determine how each test subject is feeling. Nogueira et al (2013) show that physiological signals can do this. They conclude that a mixture of electrodermal activity measured via skin conductance and cardiovascular activity measured via blood pressure and heart rate can produce an 89% accuracy for activation and an 84% accuracy for pleasure. Other methods such as facial tracking, eye movements and EEGs can also provide measurements of activation and pleasure, however these are all either too expensive to obtain or too obstructive to the player (Aminder, 2011).

Some form of emotional surveying will also be needed alongside these physiological measurements in order to gain the best understanding of the emotions experienced by the players. This could take the form of a simple questionnaire asking how the participant felt, which will likely be modelled after the game experience questionnaire designed by IJsselsteijn et al (2008) due to the extensive research that went into producing this questionnaire and the quality of results it provides.

## 2.4 Best testing practices from similar projects

By researching similar projects and how they set up their own tests and by drawing parallels to this project, a good base should be uncovered for designing the testing phase.

### 2.4.1 Participants

Suitable participants will need to be recruited for the testing phase of this project and so certain things must be decided upon such as how many participants are required and if they need to match any specific criteria. When testing for immersion in games, Nacke and Lindley (2008)

use 25 healthy, male participants and they deemed this suitable for their purpose. Bischke et al (2014) used only 11 subjects when testing how to implement biofeedback into a game environment and found that this was enough to draw conclusions from. Vachiratamporn et al (2014) also used 11 subjects to test affective adaptation in horror games, although interestingly they tested each subject 3 times to obtain 33 sets of data in total, since they found that their game was scary enough that meaningful fear and therefore results could still be produced after 3 playthroughs. For all three of these similar projects, there was apparently negligible difference in results when testing between different genders, and it also didn't matter whether the subjects were familiar with the type of game being tested. Dekker and Champion (2007) mention one issue they discovered was that players unfamiliar with the controls of the game would be more focused on learning them than in playing the game although this could be fixed with a simple tutorial stage.

#### **2.4.2 Setting**

In order to gather the highest quality results, a suitable test setting will need to be decided upon. Bischke et al (2014) test their subjects in a dark room in order to increase tension and so the subject is more focused on the game. They also only allow one other person in the room with the subject, which they describe as a moderator, who is only there to help if something goes wrong and to observe the subject. Decker and Champion (2007) also mention that the brightness of the room during testing may have affected some of their results negatively. Location appears to not affect the results if outside distractions are minimised, so this would rule out a busy lab.

All the researched literature highlights the importance of running a pilot studies and informal tests in order to identify requirements specific to the individual project and any potential issues that may rise. These pilot studies also help with understanding how to use the equipment needed for measuring physiological signals.

## **Methods**

This section will state and justify the approach to the primary research of the project. The primary objectives will be stated and described, as well as the remaining tasks that need to be completed to succeed in answering the research question and hypothesis.

### ***3.1 Develop and test***

In order to answer the research question of this project, a horror game will need to be developed along with an AI system based upon findings from an extensive literature review. This will then provide a suitable environment to test whether AI can be used to alter elements of the game to elicit a meaningful fear response in test subjects. The most suitable primary research method is therefore a develop and test method.

### ***3.2 Development of the game and AI***

A horror game will need to be developed and this will be done using the Unity game engine. This is due to previous experience with this engine, as well as access to a huge variety of assets from the Unity asset store. By completing a literature review it is apparent that games made in Unity in a short time frame can produce fear if the correct procedures are followed, which have also been identified by a review of relevant literature. Open source Unity projects will also be utilised in order to save development time. The AI will be developed using a utility approach in C# with the aid of the Apex Utility AI package available on the Asset store. This will speed up development time and allow for more complex AI to be created. An iterative approach will be taken when developing both the game and the AI since this will allow important changes to be made after pilot studies and when more information is gathered. The game will be deployed on PC which will allow for the game to be played while physiological data is measured on the same machine.

When the final iteration of the game is complete, testing will commence. This will involve test subjects playing through the game in a quiet, comfortable environment while connected to a heart rate monitor and a galvanic skin response sensor. The subjects will be observed playing the game and their gameplay will be recorded using OBS screen recording software. After they have finished their playthrough, they will be asked to complete a short questionnaire to gather important qualitative feedback, then they will be thanked and escorted out of the test environment.

Due to the use of human subjects, appropriate consent forms will need to be issued detailing the exact nature of the project and highlighting that subjects are free to leave the test at any time. Because this project deals with actively trying to produce fear in subjects no under 18s will be permitted to take part, neither will anyone with heart issues. Ethical consent will be required from the university.

### ***3.3 Remaining tasks***

#### **Finalise design choices**

While the key aspects of a successful horror game have been identified by reviewing literature, specific design choices still need to be made. This includes the exact setting of the game, what sounds will be used and what the core gameplay will be.

#### **Develop the AI system**

Once the design of the game has been finalised, the AI can be developed to fit into the game. It will have access to all the necessary parameters and be able to alter them dynamically. These parameters include sounds, lighting, enemy control and player movement.

#### **Design the testing phase**

The specific details for the testing phase will need to be decided. This will include the exact location and time of testing, the number of participants required and the design of suitable questionnaires and consent forms.

#### **Pilot studies and preliminary testing**

A key part of this project is the iterative nature of development. Pilot studies will have to be completed in order to gain valuable feedback regarding the game and the AI, as well as any issues that may arise when testing. These pilot studies will also provide a chance to learn the set up and operation for the necessary biofeedback sensors.

### **Gather a suitable group of participants**

Suitable participants will need to be recruited in some manner. This could be done via flyers, social media and by verbally asking people.

### **Carry out testing**

Once participants have been recruited and the game and AI have been fully developed, testing can begin. This will provide the raw data as well as the qualitative data required for evaluation.

### **Analyse the results and draw conclusions**

The gathered data can then be analysed in order to answer the research question and determine whether the hypothesis is correct. This will be presented in an extensive final report.

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